

ENTRANCE EXAMINATIONS – 2019

(Ph.D. Admissions - January 2020 Session)

Ph.D. Biotechnology

Duration : 2 hours

Max. Marks : 70

Hall Ticket No. **Instructions to the candidates****Please read the instructions carefully before answering the questions :**

1. Write your Hall Ticket No. in the OMR Answer Sheet given to you. Also, write your Hall Ticket No. in the space provided above.
2. Answers are to be marked on the OMR Answer Sheet (given separately) following the instructions provided thereon.
3. Hand over the **OMR Answer Sheet** at the end of the examination to the Invigilator.
4. No additional sheets will be provided. Rough work can be done in the question paper itself/space provided at the end of the booklet.
5. This Question paper consists of two parts : Part – A and Part – B contains with 35 multiple choice questions in each Part, printed in **14** pages including this page.
6. Each question carries one mark **and there is no negative marking.**
7. In case the candidates have equal marks, preference will be given towards the candidate who has obtained higher marks in **PART-A.**
8. Non-scientific Calculators are permitted.
9. Cell/Mobile Phones are strictly prohibited in the examination hall.

PART A

1. If a 100 ml of pH 2 HCl solution is mixed with a 100 ml of pH 3 HCl solution, the resultant solution pH will be,
 - A. 1.76
 - B. 2.26
 - C. 2.55
 - D. 3.26
2. $15.212 \times 2.00 =$
 - A. 30.424
 - B. 30.42
 - C. 30.4
 - D. 30
3. _____ is **NOT** an extensive property?
 - A. enthalpy
 - B. volume
 - C. heat capacity
 - D. density
4. Choose the right order of molecular covalency?
 - A. $\text{LiCl} > \text{NaCl} > \text{KCl} > \text{CsCl}$
 - B. $\text{LiCl} > \text{KCl} > \text{NaCl} > \text{CsCl}$
 - C. $\text{CsCl} > \text{NaCl} > \text{KCl} > \text{LiCl}$
 - D. $\text{CsCl} > \text{KCl} > \text{NaCl} > \text{LiCl}$
5. Which one of the following molecules has centre of symmetry?
 - A. water
 - B. ammonia
 - C. acetylene
 - D. formaldehyde
6. A bag contains 24 balls of which 'x' are red, 2x are white and 3x are blue. A ball is selected at random. What is the probability that it is **NOT** red?
 - A. $1/6$
 - B. $5/6$
 - C. $1/2$
 - D. $1/3$

7. If the price of a book is reduced by Rs.5, a person can buy 5 more books for Rs.300. Find the original list price of the book.
- A. 25
 - B. 20
 - C. 15
 - D. 30
8. The amino acid substitution that would most likely cause a change in the tertiary structure of protein is:
- A. Val to Leu
 - B. Lys to Tyr
 - C. Arg to Lys
 - D. Ser to Thr
9. The outermost electronic configuration of the most electronegative element is:
- A. ns^2np^3
 - B. ns^2np^4
 - C. ns^2np^5
 - D. ns^2np^6
10. The following genetic elements are important for the lambda growth. Describe which of the following element acts in *cis*.
- A. N
 - B. Q
 - C. Nut
 - D. Bacterial *recA*
11. Gelatin-PAGE is used to identify the inhibitory activity of the following macromolecule against the protease "trypsin".
- A. Protein
 - B. Lipid
 - C. Carbohydrate
 - D. Nucleic acid
12. The cell wall is digested by the following enzymes during the preparation of mesophyll cells in plants.
- a. Cellulase
 - b. Laccase
 - c. Macerozyme
 - d. Chitinase
- A. a,d
 - B. b,c
 - C. a,c
 - D. b,d

13. A student 'X' was advised to prepare 1.0 M Tris buffer of pH 8.2. When the Tris was dissolved in distilled water, the solution showed a pH of 12. Now, 'X' used the following chemical to bring Tris Buffer to the advised pH.
- NaOH
 - HCl
 - Acetone
 - NaCl
14. The leaves of a plant grown under 1.0 M NaCl treatment showed increase in length and width, and pale green in colour when compared with the leaves from plants grown under the normal conditions without NaCl treatment. You are advised to monitor changes in leaf area and Chlorophyll. What is the correct sequence of steps used to determine the parameters in question?
- The length and width of leaves would be measured independently followed by homogenizing leaf tissues in acetone sequentially from control and test samples and monitoring the absorbance of the solution at 660 nm using a spectrophotometer.
 - The length and width of leaves would be measured independently followed by homogenizing leaf tissues in distilled water sequentially from control and test samples and monitoring the absorbance of the solution at 660 nm using a spectrophotometer.
 - The length and width of leaves would be measured independently followed by homogenizing leaf tissues in acetone sequentially from control and test samples and monitoring the absorbance of the solution at 660 nm using a pH meter.
 - The length and width of leaves would be measured independently followed by homogenizing leaf tissues in distilled water sequentially from control and test samples and monitoring the absorbance of the solution at 660 nm using a pH meter.
15. A sample is labelled as "10 $\mu\text{g/ml}$ protein". Which one of the following reagent/method would be most sensitive to confirm the protein content labelled on the tube?
- Biuret
 - Lowry
 - Tollen's
 - Orcinol
16. If a piece of chromatin contained 200 copies of the histone H4, then how many nucleosomes would be present?
- 100
 - 200
 - 400
 - Cannot be determined

17. Assume that attached earlobes are an autosomal recessive trait with 73% penetrance. If one parent is heterozygous (Aa) and the other homozygous recessive (aa) for the attached earlobe gene, what is the probability that their first child will have attached earlobes?
- A. 50%
 - B. 18.75%
 - C. 25%
 - D. 36.5%
18. A child who is blood type A has a mother who is blood type B. In a paternity suit, a man is accused of being the father. He has blood type AB. Is he the father?
- A. Yes
 - B. No
 - C. He cannot be excluded as the father
 - D. There is a 12.5% chance that he is the father
19. How many Barr bodies are present in an individual with Klinefelter syndrome (XXYY)?
- A. 0
 - B. 1
 - C. 2
 - D. 3
20. Which one of the following DNA modifying enzymes can add one or more deoxyribonucleotides onto 3' terminus of a DNA molecule?
- A. Alkaline phosphatase from calf intestinal tissue
 - B. Polynucleotide kinase
 - C. Terminal deoxynucleotidyl transferase
 - D. Ligase
21. 5 μ l of a restriction buffer was added to a reaction mixture containing other components of the reaction. After addition of all the components the final volume became 50 μ l and the working buffer concentration was 50 mM. What was the stock concentration of buffer?
- A. 100 mM
 - B. 500 mM
 - C. 250 mM
 - D. 25 mM
22. Suppose a 1 ml bacterial culture was diluted in 9 ml of broth and serially diluted 4 more times in a similar manner (total 5 dilutions). Finally, 0.1 ml of such serially diluted culture was spread on to agar plate resulted in 200 colonies. Theoretically what could be the original number of cells per ml of culture broth?
- A. 2.0×10^8
 - B. 2.0×10^6
 - C. 2.0×10^7
 - D. 2.0×10^5

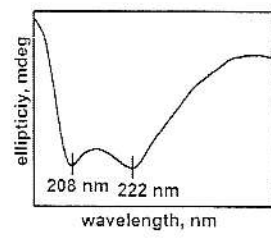
23. A bioreactor to which fresh medium is continuously added, while culture liquid containing left over nutrients, metabolic end products and microorganisms are continuously removed at the same rate is called:
- Cryostat
 - Chemostat
 - Batch Fermenter
 - Fed-batch Fermenter
24. Which of the following media is used in determining the characteristics of the isolated bacterial colony?
- Liquid media
 - Semi-liquid media
 - Solid media
 - Semi-solid media
25. During fermentation, if a foreign microorganism invades into medium. Which of the following is **NOT** likely to occur?
- The foreign microorganism may degrade the final product
 - The foreign microorganism may contaminate the final product
 - The foreign microorganism may not grow in medium
 - The foreign microorganism may outgrow the production organism
26. Some of the steps involved in DNA finger printing are listed below:
- Extraction of DNA
 - Collecting the sample
 - Treating DNA with Restriction endonucleases
 - GEL Electrophoresis
 - Transfer segments of DNA to nitrocellulose membrane
 - Hybridize with probe and autoradiography
- The correct sequence is _____
- ii, iii, iv, vi, v, i
 - ii, i, iii, iv, v, vi
 - iv, i, ii, v, iii, vi
 - i, iv, v, ii, iii, vi
27. Among the different methods, which can be used to detect *in vivo* DNA-protein interaction?
- DNA Footprinting
 - DNA Pull-Down Assay
 - Chromatin Immunoprecipitation (ChIP)
 - Electrophoretic Mobility Shift Assay (EMSA)

28. Rabbit IgG is treated with the Pepsin and Papain enzyme in different tubes. The Fab and Fc fragments obtained after proteolytic digestion were immunized in different goats and the sera were collected after 48 days following immunization. These anti-sera were used for probing the H and L chains. Which of the following statements is *Correct*?
- A. The antibody to the Fab fragment could react only to the L chain
 - B. The antibody to the Fc fragment could react only to the L chain
 - C. The antibody to the Fab fragment only could react to the H chain
 - D. The antibody to the Fab fragment could react to both the H and L chain
29. In an experiment C57B/6 mice have been exposed to a lethal dose of x-rays (950 rads) and put to different conditions; **Batch 1**: after 5 days of radiation, mice bone marrow was harvested and put for analysis; **Batch 2**: Fresh bone marrow from another C57B/6 mouse has been transferred through intravenous injection in the mice exposed to the lethal dose of x-rays; **Batch 3**: Fresh bone marrow from BALB/6 has been infused in these x-ray irradiated mice; **Batch 4**: Bone marrow from C57B/6 has been infused in SCID mice; **Batch 5**: Human bone marrow was infused in SCID mice. Which of the following is *correct*?
- A. CD34 positive cells are found to be highly increased in Batch 1 and Batch 3 mice.
 - B. Batch 2 mice will die within 10 days because of enhanced T cells and B cell activation.
 - C. SCID mice will reject the bone marrow transfused from C57B/6 mice.
 - D. Human CD34 + HSCs will be differentiated in mature HSC in SCID mice.
30. What would be the likely outcome in an experiment where a group of mice in which the CD1 family has been "*knocked out*" are immunized with *Mycobacterium tuberculosis*. Spleen cells from these mice were isolated and divided into two batches. One batch is treated with a lipid extract of the bacteria and a second batch is treated with a protein derived from the bacteria known as purified protein derivative (PPD).
- A. Batch one cells will proliferate extensively after re-stimulation with antigens
 - B. Batch two cells will proliferate after re-stimulation with antigens
 - C. Batch one cells will proliferate better than batch 2 cells after re-stimulation with antigens.
 - D. None of the above
31. A nurse accidentally administered a drug to a newborn that destroyed the thymus, what would most likely happen?
- A. His cells would lack class I MHC molecules on their cell surface
 - B. His humoral immunity would be missing
 - C. Genetic rearrangement of antigen receptors on B cells would not occur
 - D. His T cell precursor would not mature and differentiate appropriately
32. Which of the following alignment methods would be most suitable to find conserved patterns in DNA or Protein sequences?
- A. Pair wise sequence alignment
 - B. Multiple sequence alignment
 - C. Local alignment
 - D. Global alignment

33. Which of the following pattern is formed by palindromic sequences in a dot plot?
- A. One diagonal line
 - B. Two intersecting diagonal lines
 - C. Two parallel diagonal lines
 - D. A diagonal line with multiple breaks
34. The monomeric subunits of a dimeric protein can be separated by β -mercaptoethanol treatment indicates
- A. the monomeric subunits interact with each other by electrostatic interactions
 - B. the monomers are joined by covalent bonding
 - C. the monomeric subunits are associated with each other due to coordinate bonds through their common metal cofactor
 - D. large number of hydrogen bond interactions between the monomeric subunits
35. Unit of second-order rate constant is
- A. $M s^{-1}$
 - B. $M^2 s^{-1}$
 - C. $M^{-1} s^{-1}$
 - D. $M^{-2} s^{-2}$

PART B

36. The given circular dichroism spectrum shows a typical signature of
- A. α -helix
 - B. β -sheet
 - C. mixture of α -helix and β -sheet
 - D. random coil



37. Collagen is
- A. a right-handed bundle of three parallel, right-handed helices
 - B. a right-handed bundle of three parallel, left-handed helices
 - C. a left-handed bundle of three anti-parallel, right-handed helices
 - D. a left-handed bundle of three anti-parallel, left-handed helices
38. At the substrate concentrations where the rate of enzyme-substrate reaction reaches a maximum (V_{max}), the reaction follows _____ kinetics.
- A. zero order
 - B. First order
 - C. Pseudo first order
 - D. Second order
39. An increase in solvent polarity results in a _____ shift in the fluorescence spectrum of a fluorophore.
- A. Hypochromic
 - B. Hyperchromic
 - C. Bathochromic
 - D. Hypsochromic
40. During splicing, which of the following snRNPs bind to a nucleotide sequence found in the 5' end splice site of the pre-mRNA?
- A. U1
 - B. U2
 - C. U4 and U6
 - D. U5
41. Which of the following transcription factor plays a role in nucleotide excision DNA repair?
- A. TFIIIE
 - B. TFIIIF
 - C. TFIIH
 - D. TFIIID

42. A mutation deleting an upstream activating sequence for a single gene would be expected to be

- A. Trans-dominant
- B. Cis-dominant
- C. Silent
- D. Reversible

43. Which one of the following is true?

- A. Epigenetics means alteration of both genotype and phenotype upon environmental changes
- B. Epigenetics does not involve a change in DNA sequence
- C. Epigenetics involves mutation in DNA sequence
- D. Gregor Mendel coined the term 'Epigenetics'

44. Identify the correct matching from Part I and Part II in the table given below :

	Part I				Part II			
	(i)				(a)			
	(ii)				(b)			
	(iii)				(c)			
	(iv)				(d)			
	(i)	(ii)	(iii)	(iv)				
A.	b	c	d	a				
B.	c	d	b	a				
C.	d	c	a	b				
D.	d	a	b	c				

45. The reactions which occur in bundle sheath cells

- a. Pyruvate to Alanine
 - b. Aspartate to Oxaloacetate
 - c. Pyruvate to phosphoenolpyruvate
 - d. Malate to pyruvate
- A. a,b,d
 - B. a,b,c
 - C. b,c,d
 - D. a,c,d

46. One of the following statements is correct during regulation of glycolysis.

- A. PEP inhibits the activity of phosphofructokinase in animals
- B. Fructose 1,6-bisphosphate stimulate the activity of pyruvate kinase in plants
- C. PEP inhibits the activity of phosphofructokinase in plants
- D. Fructose-6-phosphate stimulate the activity of pyruvate kinase in animals

47. The molecule which does **NOT** have biological significance with reference to Nitrogen metabolism

- A. Adenine
- B. Chlorophyll a
- C. Zeatin
- D. Flavanone

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48. Glucosinolates are derived from the amino acid
- A. Methionine
 - B. Cysteine
 - C. Glutamate
 - D. Lysine
49. Mismatch repair requires the ability to distinguish between template and newly synthesized DNA strands. How can *E. coli* distinguish between these two strands?
- A. Template DNA is methylated
 - B. New DNA is methylated
 - C. Template DNA is phosphorylated
 - D. New DNA contains single-stranded binding proteins
50. While studying *Arabidopsis*, a researcher isolates a gene mutation that produces a shorter stem-height phenotype. Interestingly, when this gene is not mutated (wild-type plant) and the seedling is germinated at a lower temperature of 12°C, the same short-stem phenotype is observed. This phenomenon is known as:
- A. epistasis
 - B. anticipation
 - C. phenocopy
 - D. genomic imprinting
51. When multiple alleles can be expressed it is termed _____, and when there is a hierarchy of dominance it is termed _____.
- A. codominance; allelic series
 - B. codominance; incomplete dominance
 - C. allelic series; codominance
 - D. incomplete dominance; codominance
52. A fruitfly is found that has three sex chromosomes (XXY) and three of each autosome. The sex of this fruitfly is _____ because _____.
- A. female; it has a 1:1 ratio of sex chromosomes to autosomes
 - B. male; it has a Y chromosome
 - C. female; it has 2 X chromosomes
 - D. intersex; it has an X:A ratio between 0.5 and 1
53. Gram-negative filamentous oxygenic photosynthetic bacteria containing phycobiliproteins
- A. *Chlorobium limicola*
 - B. *Nostoc punctiforme*
 - C. *Nitrospira marina*
 - D. *Clostridium botulinum*

54. Identify non-symbiotic nitrogen fixing prokaryotes
- I. Clostridium
 - II. Rhodobacter
 - III. Rhizobium
 - IV. Frankia
- A. I and II
 - B. I and III
 - C. II and III
 - D. III and IV
55. The commercially useful enzymes collagenase and glucose isomerase are produced by _____ and _____ respectively.
- A. *Trichoderma konigi* and *Clostridium histolyticum*
 - B. *Clostridium histolyticum* and *Streptomyces phaeochromogenes*
 - C. *Rhizopus spp.* and *Bacillus subtilis*
 - D. *Saccharomyces cerevisiae* and *Aspergillus oryzae*
56. Which of the following proteins are phosphorylated during transcription elongation?
- A. CTD
 - B. TBP
 - C. Sigma factor
 - D. TFIIF
57. The 2018 Nobel Prize in Medicine was awarded to immunologists James Allison of MD Anderson Cancer Centre and Tasuku Honjo of Kyoto University for their work on protein on the surface of T cells, which plays a crucial role in Cancer immunotherapy. Which of the following statement is *correct*?
- A. Their work on only T-cell protein CTLA-4 resulted in Nobel Prize.
 - B. Their work on only PD-1 proteins resulted in Nobel Prize.
 - C. Allison and Colleagues worked on CTLA-4, Honjo and his colleagues worked on PD-1.
 - D. Allison and Colleagues worked on CD28 for which they received Nobel prize.
58. The $\alpha\beta$ T cells recognizes antigenic peptides
- A. only in the free form
 - B. only when loaded onto MHC molecule
 - C. only when bound to hapten
 - D. only when bound by antibodies
59. Which of the following are **NOT** Antigen presenting cells?
- A. CD11c⁺ Dendritic cells
 - B. Follicular Dendritic cells
 - C. B cells
 - D. Macrophages
60. Which of the following differentiates T cell and B-cells?
- A. T cells but not B cells are stimulated to increase the rate of cell cycles.
 - B. Only B cells are produced from stem cells of the bone marrow.
 - C. T cells but not B cells can directly attack and destroy invading pathogens.
 - D. T cells but not B cells have surface markers.

61. Class switching occurs in B cells to produce IgG from IgM, which of the following conclusions is *correct*?
- A. Specificity of the IgG and IgM are different from each other
 - B. Specificity of the IgG is same as IgM
 - C. The molecular weight of the new antibody is same as the old one
 - D. The valency of the new antibody is same as the old one
62. T helper cells after receiving proper signals from Antigen presenting cells differentiate to the following effectors cells. Which of the following statement is *incorrect*?
- A. IL-12 promotes naive T cells differentiation into Th1 cells
 - B. IL-10 promotes naive T cells differentiation into Th2 cells
 - C. Th17 play important role in autoimmunity
 - D. Th2 cells produces IFN-gamma cytokine
63. The Oral Polio Vaccine (OPV) administered to children's in India is
- A. inactivated polio vaccine
 - B. live attenuated poliovirus
 - C. Subunit Vaccine for Oral route
 - D. Recombinant Vaccine
64. Which of the following is *incorrect* about $\gamma\delta$ T cells ?
- A. $\gamma\delta$ T cells lack both CD4 and CD8
 - B. They recognize a microbial phospholipid antigen
 - C. $\gamma\delta$ TCR binds to nonclassical self-MHC molecule
 - D. Number of $\gamma\delta$ T cells in circulation is large compared to $\alpha\beta$ T cells
65. The class of immunoglobulin that can get transported across epithelial cells is
- A. IgG
 - B. IgE
 - C. IgA
 - D. IgM
66. At what age does the thymus reach its maximal size?
- A. During the 1st year of life
 - B. Teenage years (Puberty)
 - C. Between 40 and 50 years of age
 - D. After 70 years of age
67. The disease caused by 'adeno virus' is
- A. Conjunctivitis
 - B. Pharyngitis
 - C. Pneumonia
 - D. All

68. Which of the following is an 'oncogenic virus'?
- A. HBV
 - B. HCV
 - C. HIV
 - D. All
69. The virus that replicates in cytoplasm is
- A. Herpes virus
 - B. Hepadna virus
 - C. Retro virus
 - D. Pox virus
70. Which of the following is known as 'dependent virus'?
- A. Hepatitis A virus
 - B. Hepatitis B virus
 - C. Hepatitis C virus
 - D. Hepatitis D virus